

ISP Freetown Fine Chemicals Inc.
WASTEWATER TREATMENT SYSTEM OPERATION

The ISP Freetown facility manufactures various polymers used in health and beauty products such as hair gels, hair sprays, skin creams and sun screens. The chemical manufacturing operations and research/development laboratory pilot scale operations conducted at the facility, as well as additional mechanical and environmental support systems (including an ion exchange water treatment system, an isopropanol recovery distillation system, a steam boiler unit, the cooling tower system, and a fume scrubber unit) generate contaminated wastewaters that require pretreatment prior to discharge into the City of Fall River sewerage system.

Pretreatment consists of wastewater flow equalization, neutralization by chemical addition, inorganic and organic solids removal/separation by flocculation, clarification, dissolved air flotation, and polish filtration, dissolved organic compound (i.e., volatile and miscible solvents) removal by steam stripping distillation, final neutralization, and sludge handling/treatment by gravity thickening and dewatering processes.

Wastewater Collection System

The wastewaters generated in the Building F-5 Production Plant and F-2 Boiler Plant flow by gravity through a channel directly to the WWTP lift sump. Wastewater from the Building F1 QA/QC Laboratory, the F4 Research Laboratory, and the F4 Pilot Plant is collected in one of two 14,000 gallon above ground storage tanks and sampled prior to discharge to the WWTP lift sump.

Spill Diversion System

The wastewaters from Building F-5 are monitored for total organic carbon (TOC) by an in-line flow analyzer located upstream of the lift station sump and Manhole No. 9, in a manhole near Building F-5. If elevated TOC concentrations levels are detected then an alarm is activated to alert the operator. A flow control valve is subsequently closed (i.e., by manual operation), and the wastewater is diverted to one of two spill diversion tanks (each with a 16,000 gallon capacity). A pump located at Manhole No. 9 is utilized for this flow diversion.

Bar Rack

The channel is equipped with an in-line manually-cleaned bar rack designed to remove heavy solid materials, thereby protecting downstream pumping equipment. Under normal conditions, wastewater passing through the bar rack flows directly into a 5,000 gallon lift station sump.

Lift Sump

The Lift Station Sump is provided with an automatic duplex pump control system, which is comprised of a liquid level sensor mounted in the sump and a duplex control panel mounted in the Control Building F-13. The system automatically controls the pumping of combined wastewaters from the sump to either a 250,000 gallon above ground equalization tank or to the above noted spill diversion tanks. Transfer of the wastewater is accomplished by three (3) self-priming lift pumps (P-1303 A, B, and C), each with a capacity of 250 gallons per minute (gpm) at 85 feet total dynamic head (TDH). Vapor phase flammability, as measured by the lower explosive limit (LEL), is monitored in the sump.

Equalization System

Wastewaters from the lift sump are directed to the above ground equalization tank (S-1304). The equalization tank has a capacity of 250,000 gallons. The tank is designed to equalize concentration fluctuations of the incoming wastewater and to attenuate the effects of flow surges (due to the nature of a batch processing facility) on the downstream treatment equipment. The contents of equalization tank are continuously agitated by a 15 horsepower side mounted mixer (M-1304), and liquid level and temperature controls mounted in the tank provide continuous monitoring of the wastewater flow.

Primary/Secondary Neutralization system

Wastewaters flow by gravity from the equalization system to the two-stage neutralization system. Equalized wastewater flows through an in-line flow control valve and enters the primary neutralization tank (S-1305). The rate at which the wastewater enters tank S-1305 is controlled by a flow control valve which is modulated by the liquid level controller located in the equalization tank (S-1304). The flow is modulated to maintain a constant level in tank S-1305.

The pH of the influent wastewater to tank S-1305 is adjusted by the addition of either sodium hydroxide or sulfuric acid, as required, depending upon whether the pH must be raised or lowered to effect the precipitation of dissolved solids. The partially neutralized wastewater then flows by gravity to the secondary neutralization tank (S-1306) for further fine pH adjustment. Again, either sodium hydroxide or sulfuric acid is added as required.

Flocculation and Clarification Systems

Inorganic and organic solids separation is accomplished via a Dissolved Air Flotation (DAF) system or in the integrated clarification system (ICS), which consists of a rapid mix chamber, a flocculation chamber and a lamella plate clarifier unit. The DAF unit can be operated in parallel or series with the ICS, but is most commonly used in parallel with the solids removal system

In both cases, pretreated wastewater from the neutralization system is pumped to a rapid mix chamber where coagulant chemicals and polymer solutions are injected into the wastewater with mixing to facilitate complete contact between the influent wastewater and the treatment chemicals.

In the DAF, the wastewater is flows into the cone-shaped DAF chamber, where micro-bubbles float the solids to the top of the cone. The clarified supernatant underflow is discharged to the steam stripper process feed tanks while the sludge generated at the top of the DAF is processed via the sludge handling/treatment system

In the ICS, the wastewater then flows by gravity into the flocculation chamber (Tank S-720B) where the wastewater is gently agitated. This gentle mixing allows the solid particles to collide and increase in particle size to enhance gravity liquid-solids separation in the clarifier unit. Following solids flocculation, the wastewater flows by gravity into the inclined plate clarifier tank (Tank X-720). The relatively large floc particles are allowed to settle in the clarifier sludge reservoir through use of incline plates located in the clarifier unit. The clarified supernatant overflow is discharged to the steam stripper process feed tanks while the sludge generated at the bottom of the clarifier is processed via the sludge handling/treatment system.

Sludge Handling/Treatment System

The solids collection and dewatering system consists of a sludge storage/thickening tank (S-720C) and an automatic plate and frame filter press (F-718). Solids are transferred to S-720C from the ICS and the DAF. The sludge is subsequently transferred to the filter press and dewatered, thus forming a solid cake.

Stripper Feed System

Clarified wastewater from the ICS and/or DAF collects in two hydraulically connected 5,000-gallon stripper feed tanks (S-707A and S-707B). The feed tanks provide (1) storage capacity for fluctuating wastewater flow rates, (2) water for granular media filter backwashing, and (3) collection of bottoms recycle as needed from the stream stripping system. Feed to the stripping column (T-711) is pumped from the feed tanks through granular media filters (F-708A and F-708B).

Granular Media Pressure Filtration

The multi-media filters remove suspended solids remaining in the feed water after the clarification process and prior to entering the steam stripping column. The multi-media filters are sized to remove high suspended solids concentrations in the event the clarifier fails in achieving its treatment goals. In this situation, the amount of solids removed by the multi-media filters will increase and require more frequent filter backwashing. Filter backwash and rinses are directed to the common drain, which flows by gravity into a pipe which drains into the lift station sump. The multi-media filter equipment is controlled by the steam stripper interlock system.

Steam Stripping

The stripping tower (column) separates dissolved organic compounds from the wastewater by enhancing the vaporization of the organic compounds. Steam enters the bottom of the column below Tray No. 1 and flows upward, removing organic chemicals from the downward flowing wastewater. This organic free water is subsequently directed to the sample monitoring station prior to discharge into the sewer. Some of the steam will condense and flow with the downward flowing water to satisfy the stripper heat balance.

The overhead vapors from the stripper column will contain a mixture of steam and organic vapors, which will vary in organic concentration. These overhead vapors are condensed in the shell-and-tube main condenser, which uses cooling tower water as a cooling medium. The organic product phase is collected and stored for off-site disposal while the water phase is re-cycled back to the stripping column as reflux. The main condenser condensate is sent to the primary decanter. Vapors, which cannot be condensed in the main condenser, are sent to the chilled glycol condenser.

Final Neutralization system

Wastewater flow is pumped from the stripper column to the final neutralization system tank (S-1314). The pH of the wastewater is adjusted by the addition of either sodium hydroxide or sulfuric acid, as required, depending upon whether the pH must be raised or lowered to ensure compliance with the effluent discharge pH limit.

Effluent Monitoring System

Treated wastewater meeting permit requirements is discharged from the WWTP to the wastewater discharge monitoring station. The monitoring station measures and records pH, temperature and flow. Automatic sampling is also conducted at the monitoring station as required under ISP's Industrial Sewer Use Permit issued by the Fall River POTW and the MA DEP sewer connection permit.

Vapor Collection

The vapor spaces in the lift station sump, spill diversion tanks, equalization tank, and neutralization tanks are connected via a blower to a set of vapor-phase, activated carbon canisters. This significantly minimizes organic discharges to the atmosphere. The stripper feed tanks, sludge feed tank, and clarifier also vent to carbon canisters.

Secondary Containment System

Secondary containment is provided for all tanks to contain each tank's volume in case of leakage or rupture.